Section 5

Advanced Land Imager (ALI) Design Overview

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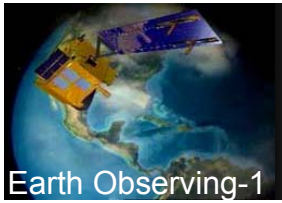
Topics of Discussion

- ***Introduction***
- ***Key specifications***
- ***Technology description***
- ***Design overview***
- ***Summary***

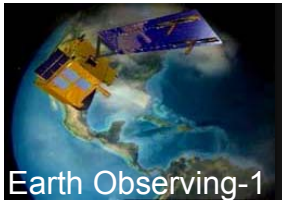
Introduction

- ***Primary instrument on the first Earth Observing Mission (EO-1) of NASA's New Millennium Program (NMP)***
- ***Objectives are to flight validate key technologies***
  - ***Data continuity, advanced capability and cost reduction for future Landsat instruments***
  - ***Innovative approaches to future land imaging***
- ***The ALI instrument was designed and developed by MIT Lincoln Laboratory with NMP instrument team members***
  - ***Raytheon SBRS for the focal plane system***
  - ***SSG Inc. for the optical system***



Instrument Design Process

- ***Instrument architecture emerged from technologies represented on the NMP IPDT***
- ***Flight validation was required to significantly reduce the risk for future missions***
- ***Design must be scaleable to a full-up instrument***
- ***Flight data must be amenable to science validation***
- ***Measurement requirements were developed***
  - ***From the bottom up by the IPDT***
  - ***In collaboration with the earth science community***



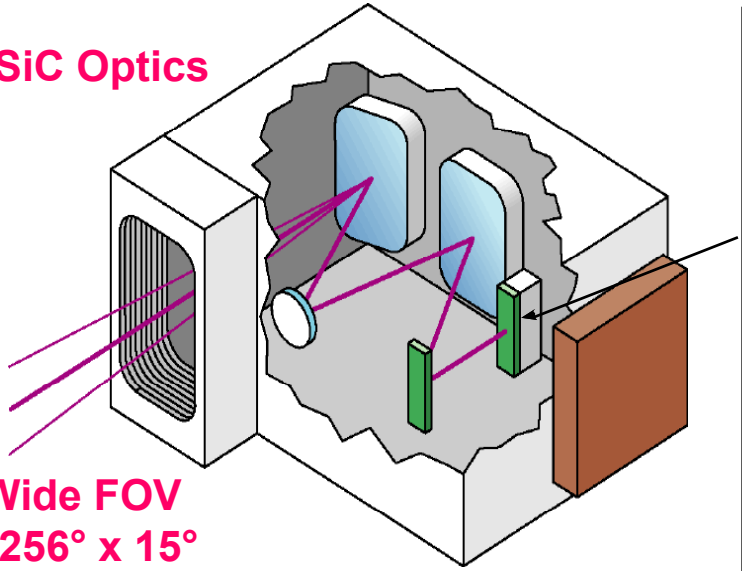
Key ALI Specifications

- ***Meet or exceed ETM+ performance (w/o thermal band) at minimum size, weight, schedule, and cost***
- ***Spectral band suite was augmented for science reasons***
  - ***Split band # 4 into two sub-bands***
  - ***Add bands at 442 nm and 1244 nm***
  - ***Reduce spectral width on the Pan band***
- ***Pan band GSD reduced to 10m***
- ***Dynamic range to cover >100% albedo with one gain state***
- ***Minimum sensor size driven by image sharpness (MTF)***
- ***SNR four to ten times ETM+ values, depending on band***
- ***Demonstrate spatial, spectral, and radiometric calibration for large detector arrays***
- ***Other performance goals guided by Landsat-7***

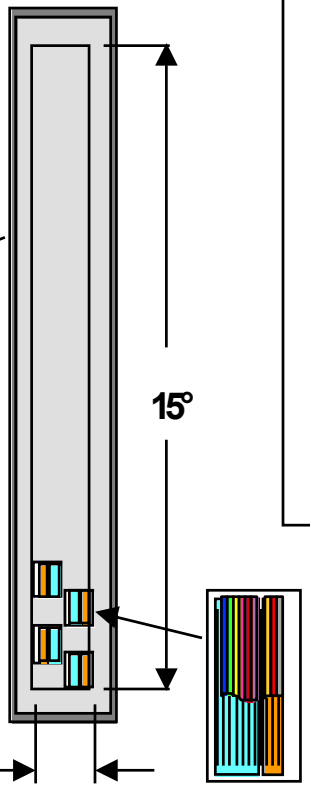
Advanced Land Imager (ALI)

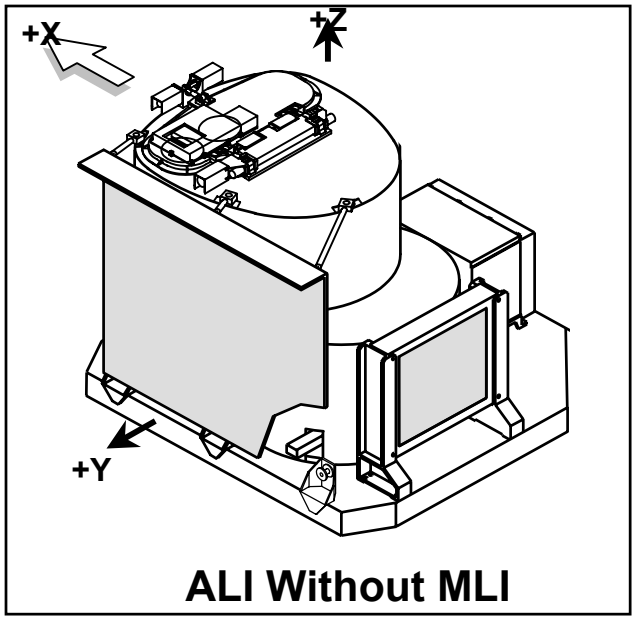
Main Focal Plan Assembly

SiC Optics



Wide FOV
1.256° x 15°





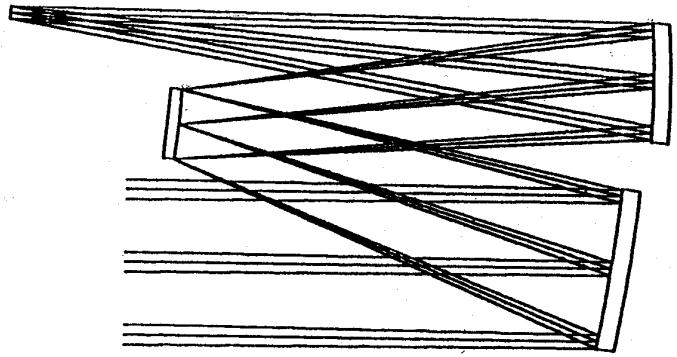
ALI Without MLI

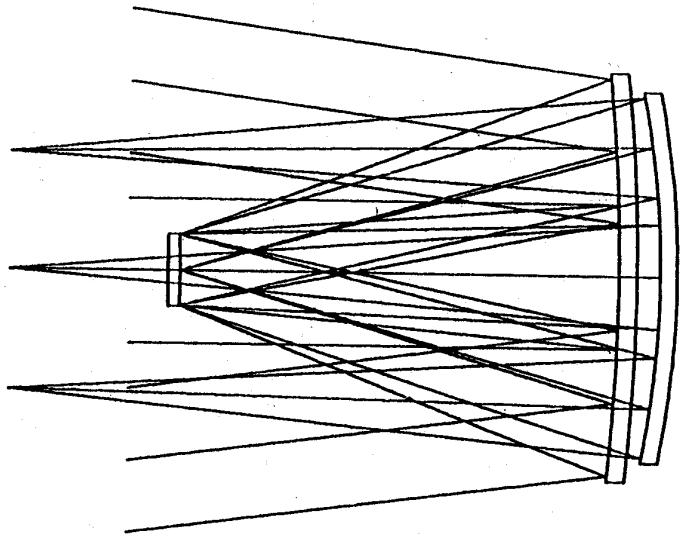
Band	Ground Sampling
Pan	10 m
MS	30 m

Multispectral
Panchromatic +
6 VNIR + 3 SWIR
220 K

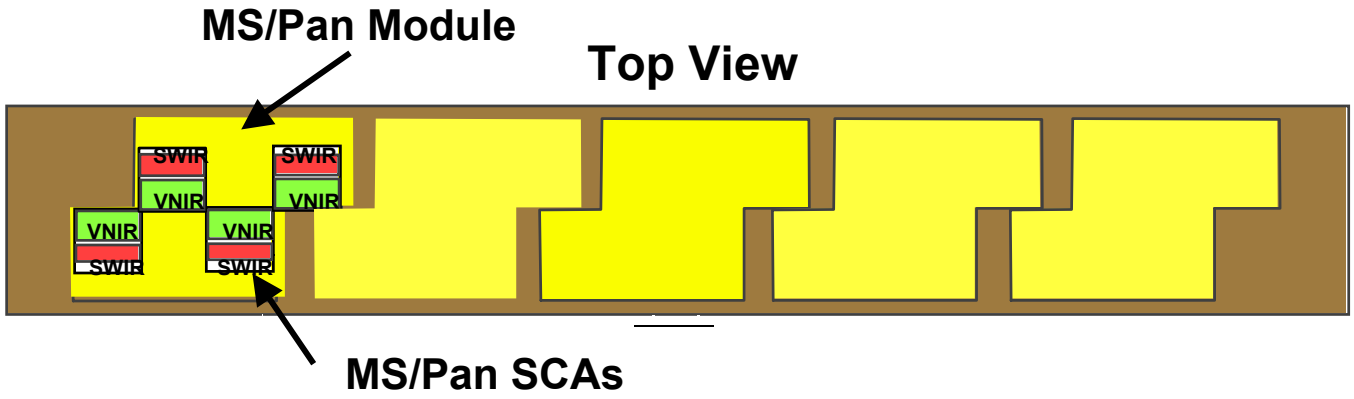
ALI Optical Design Form

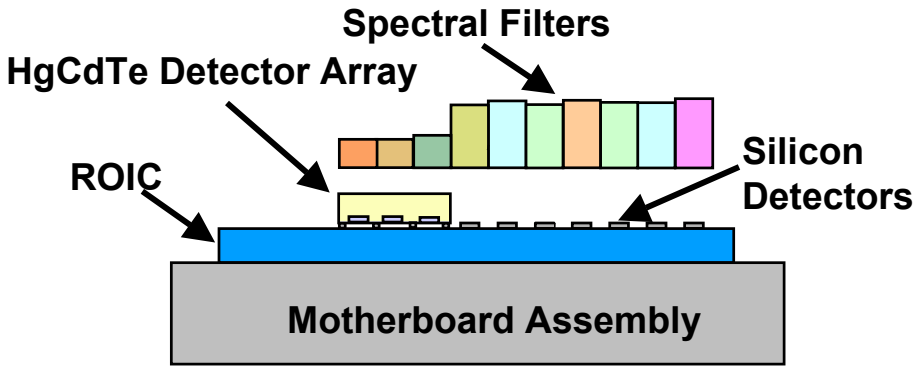
- ***All reflective Cooke Triplet***
  - ***Aspheric primary***
  - ***Ellipsoidal secondary***
  - ***Spherical tertiary***
- ***Aperture stop on secondary mirror***
- ***Non-relayed design***
- ***Near telecentric***
- ***FOV = 1.256 x 15 degrees***





Main Focal Plane Assembly

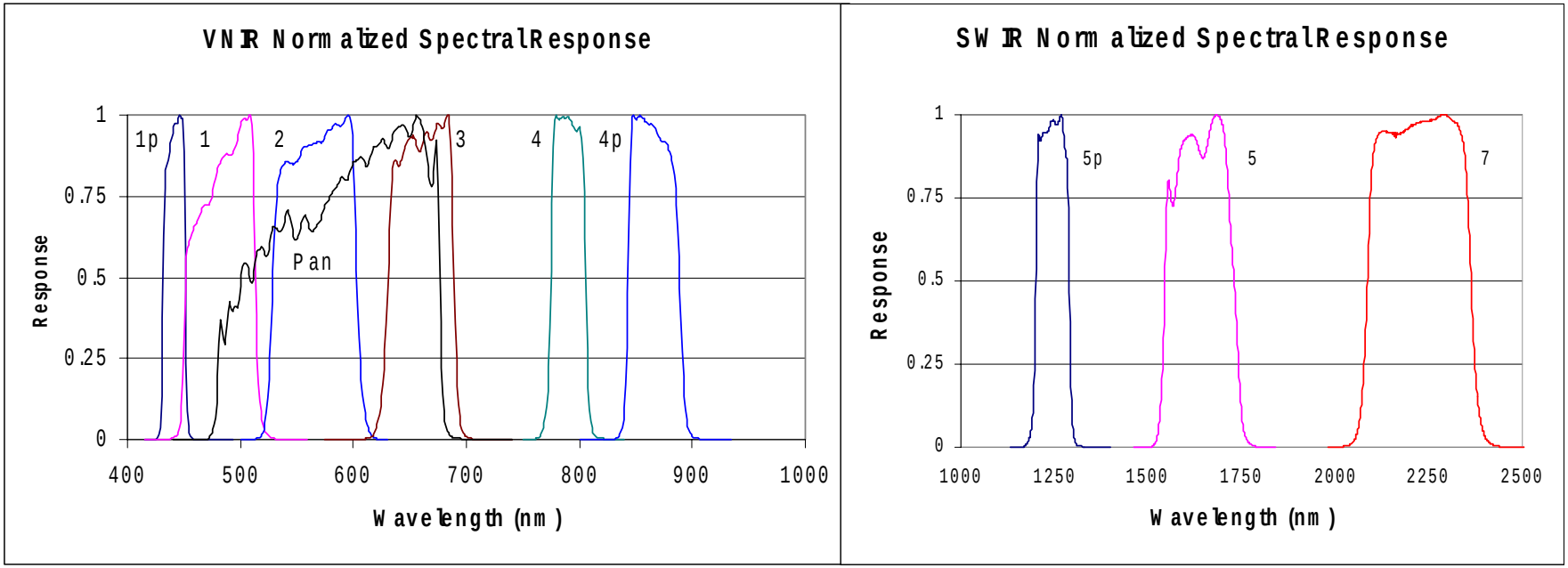




MS/Pan SCA

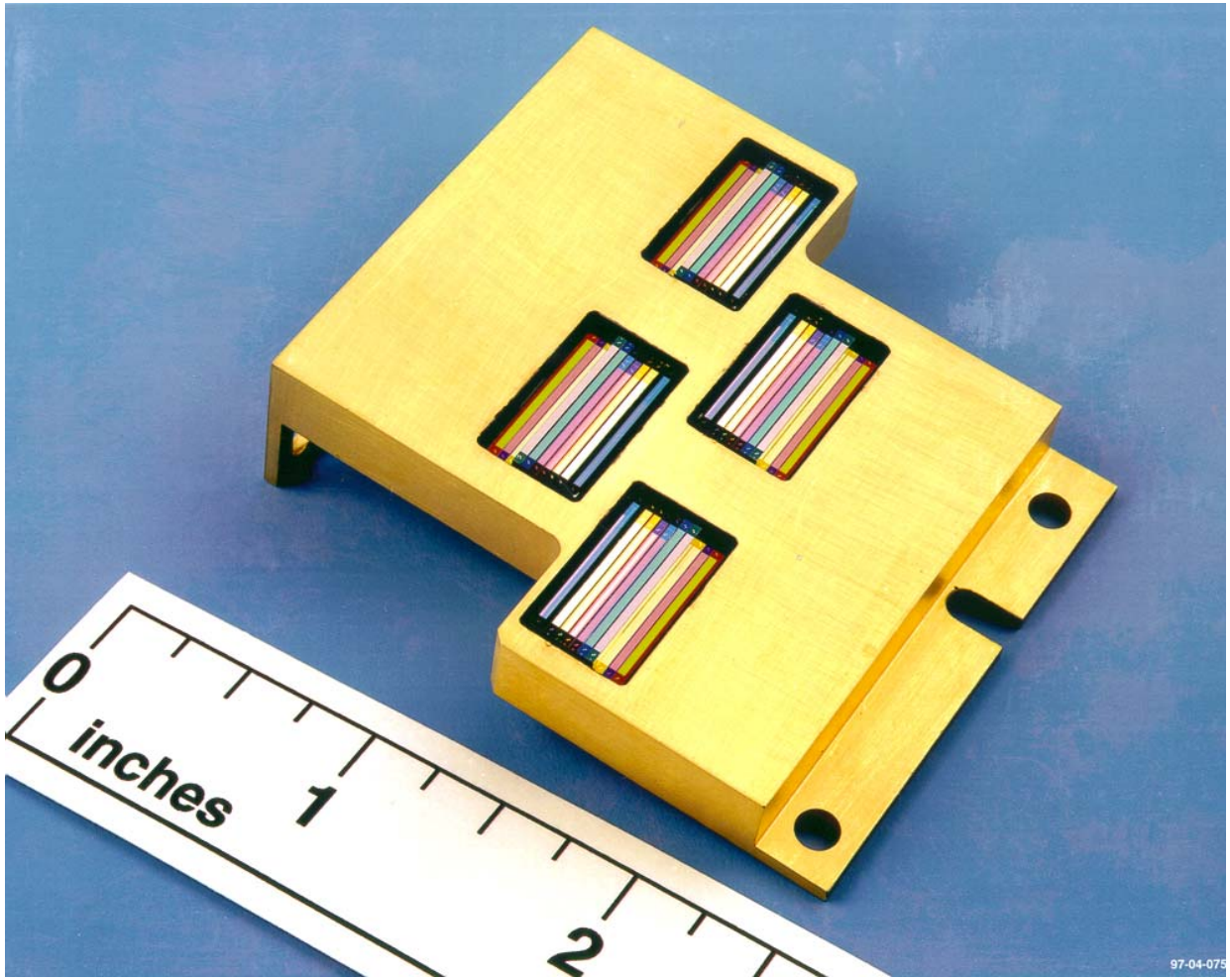
MS : Multispectral
Pan : Panchromatic
ROIC : Read-out Integrated Circuit
SCA : Sensor Chip Assembly
SWIR : Short Wave Infrared
VNIR : Visible Near Infrared

ALI Spectral Response Functions

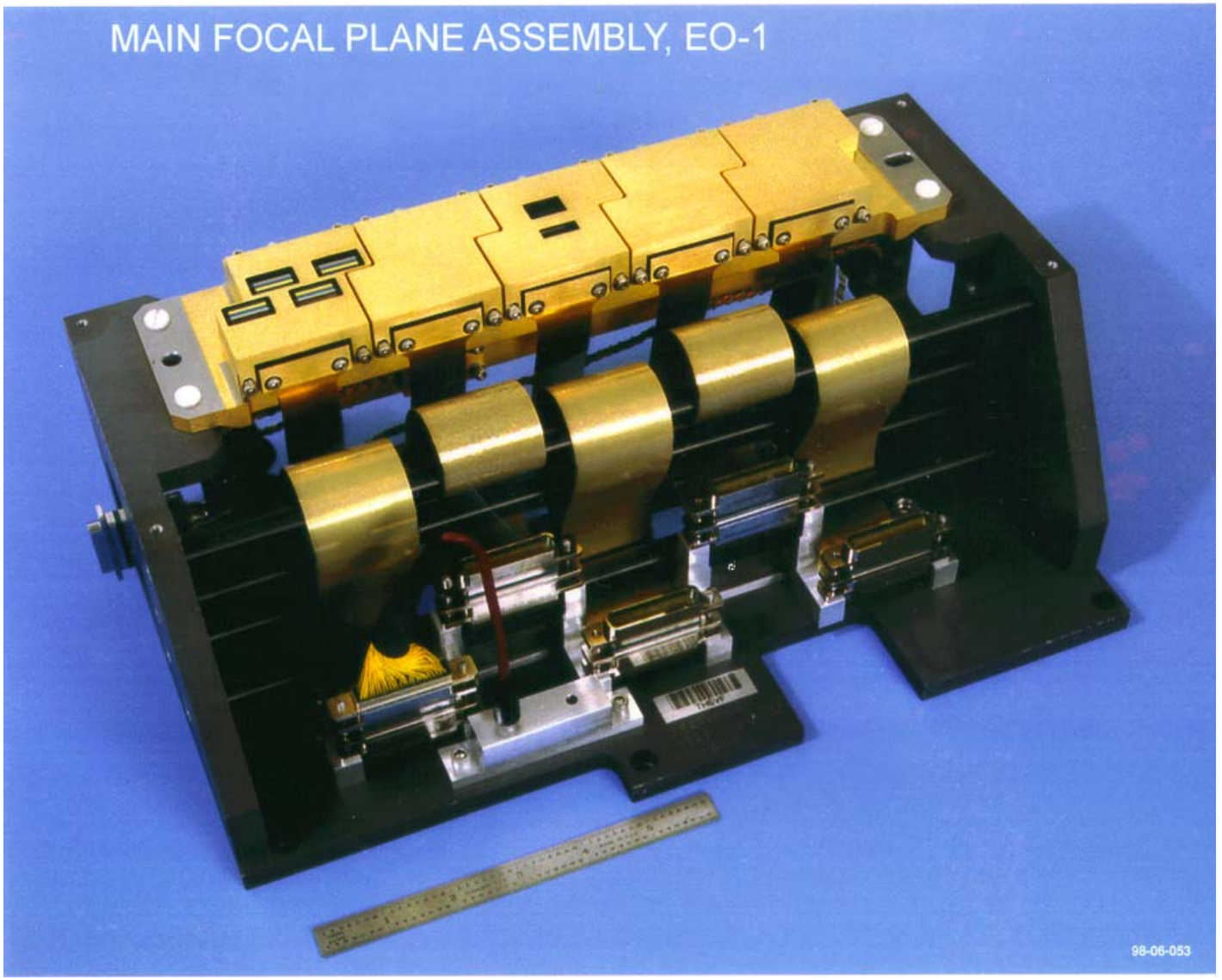


ALI Bands	1p	1	2	PAN	3	4	4p	5p	5	7
Wavelength (nm)	442	485	567	592	660	790	866	1244	1640	2226
Bandwidth (nm)	19	53	70	144	56	31	44	88	171	272

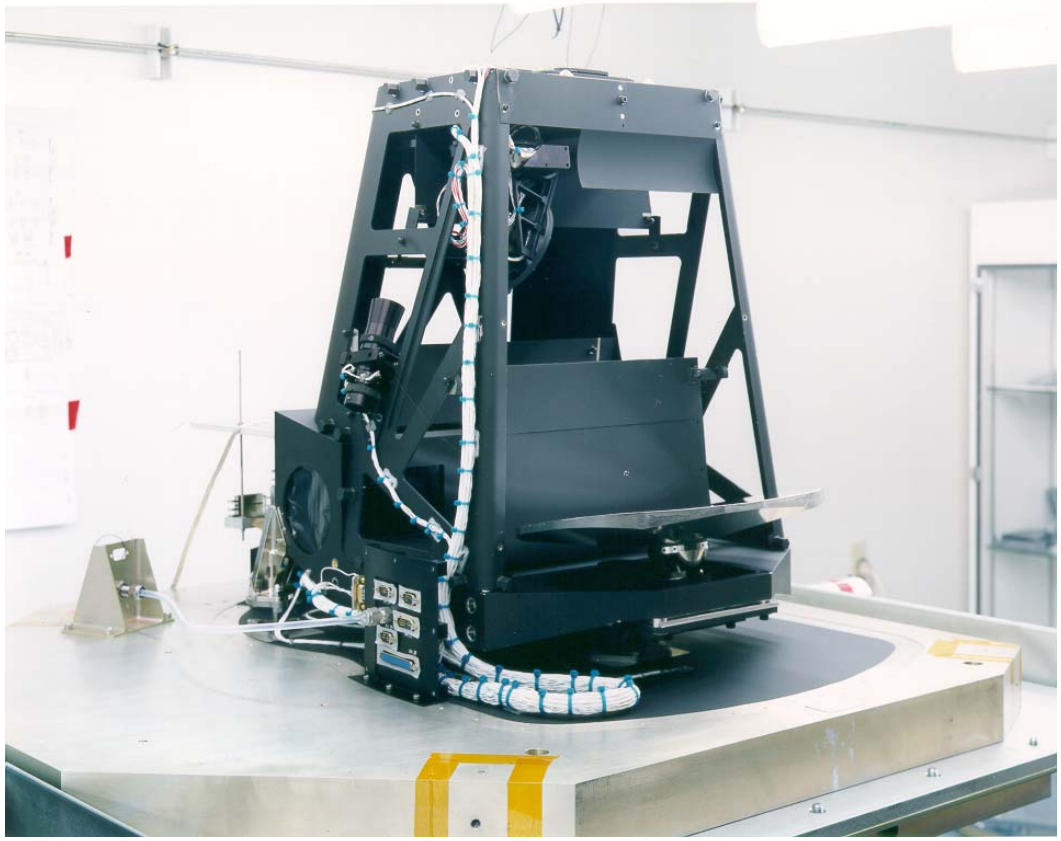
MS/PAN Flight Module



Main Focal Plane Assembly

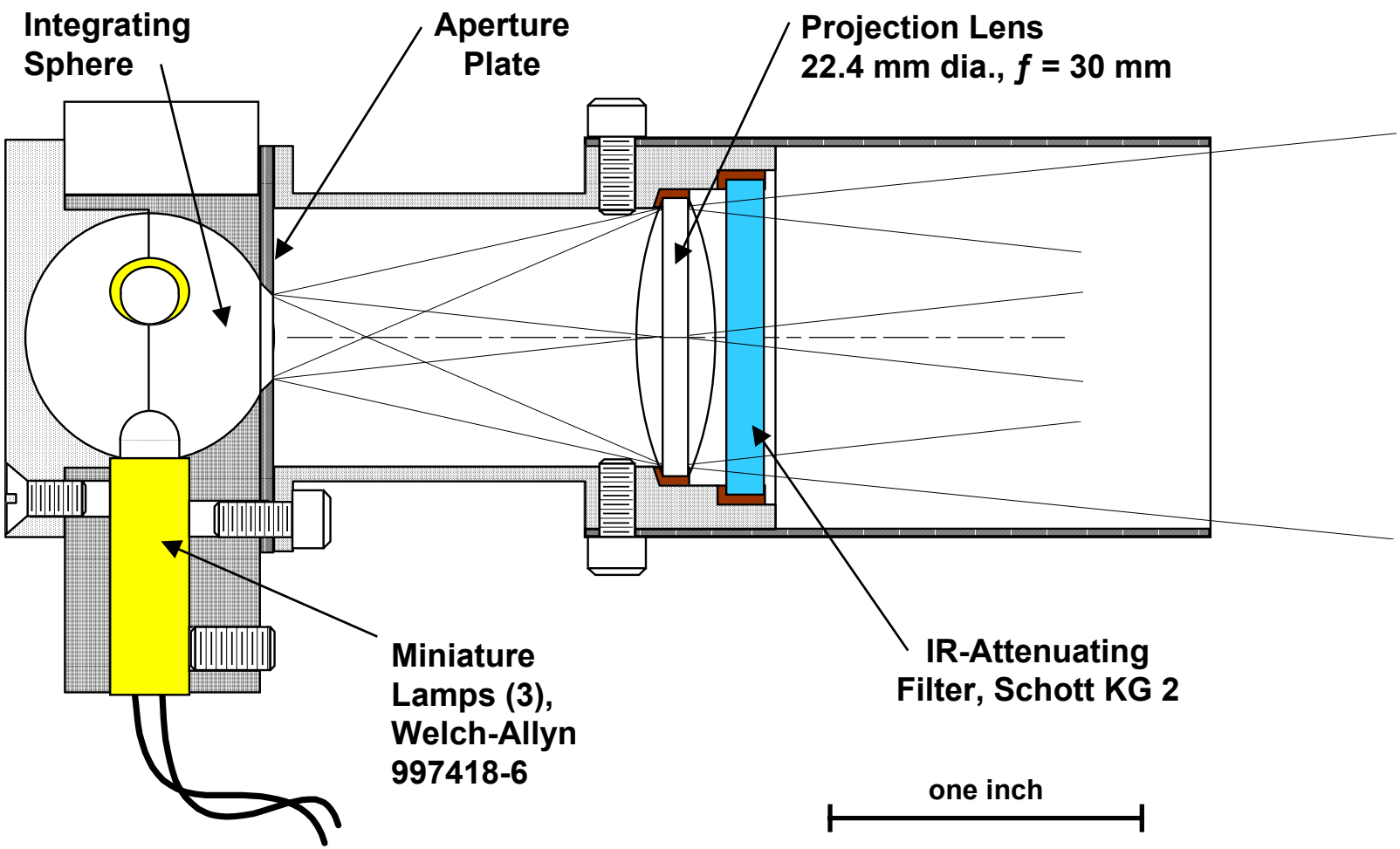


Partially Assembled Flight ALI



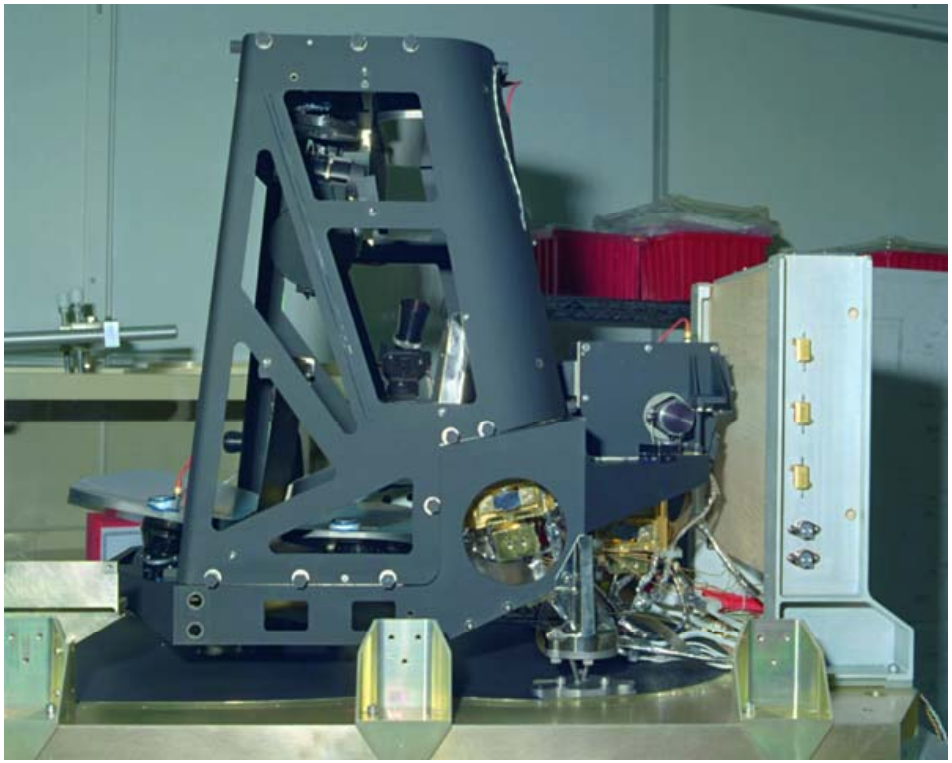
- ***Telescope features***
  - ***12.5 cm entrance pupil***
  - ***15° x 1.26° field-of-view***
  - ***Telecentric, f/7.5 design***
  - ***Unobscured, reflective optics***
  - ***Silicon carbide mirrors***
  - ***Wavefront error: = 0.11 l RMS @ 633 nm***

Internal Reference Source



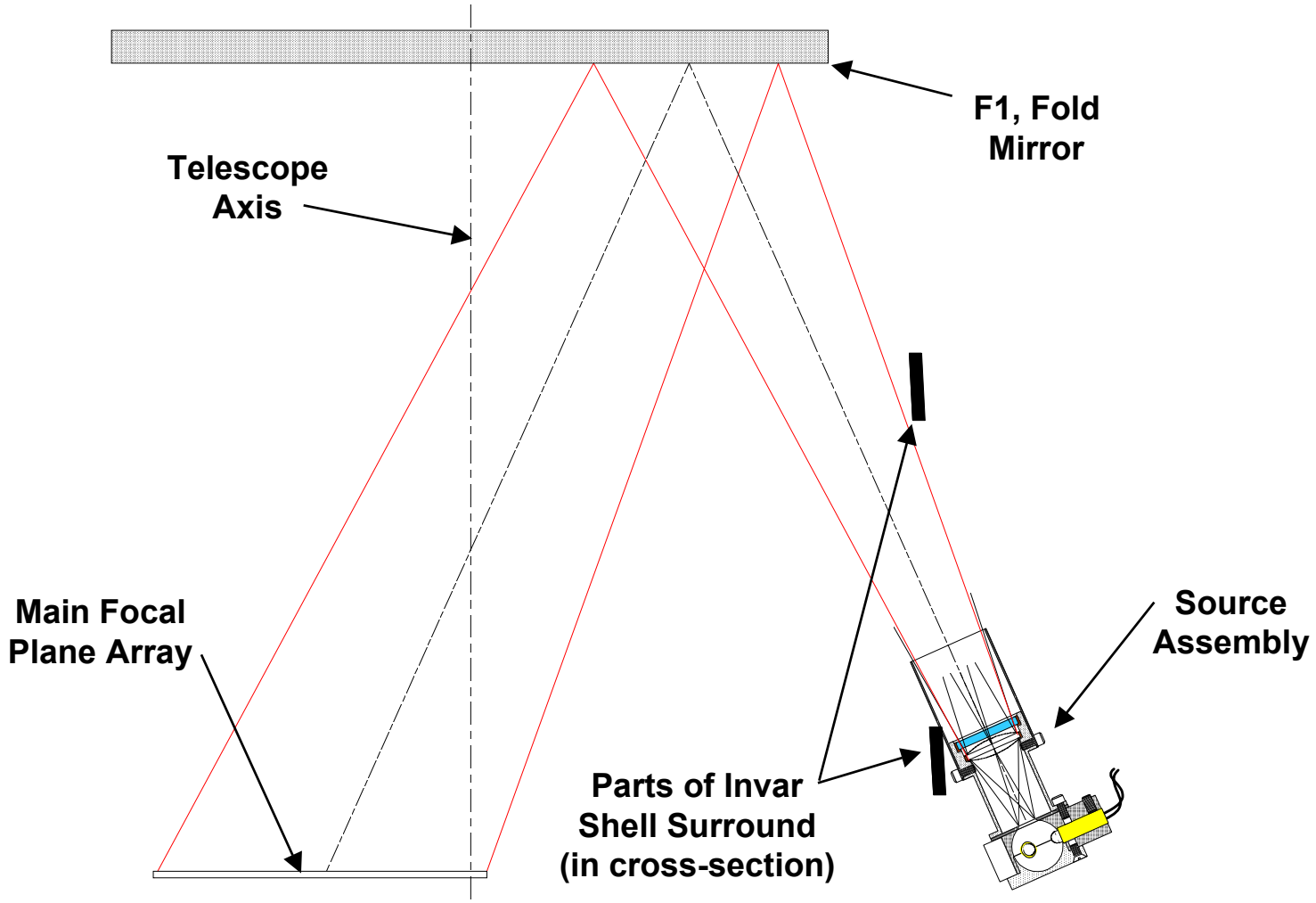
Internal Reference Source

Lamp Assembly

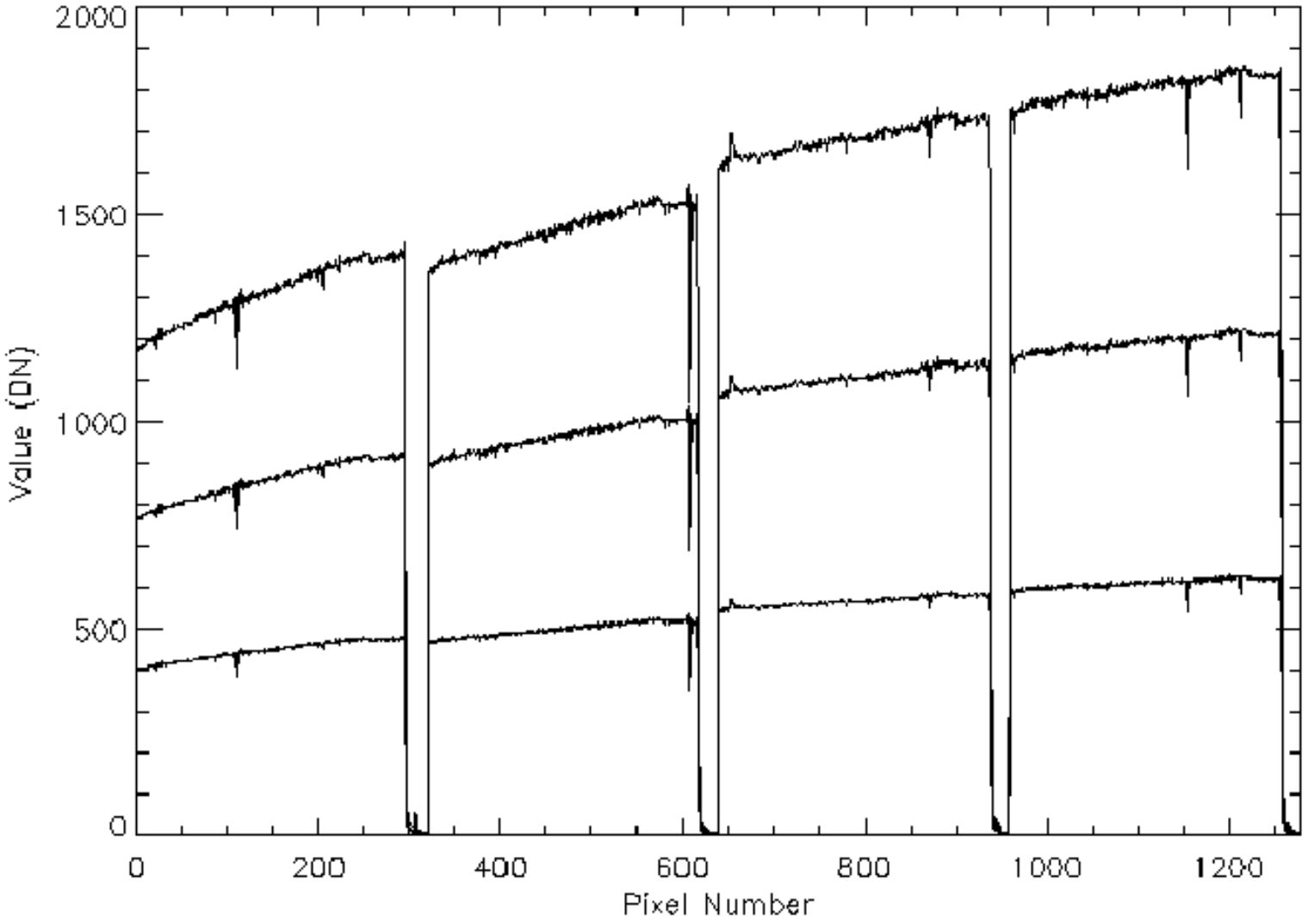


Lamp Installation

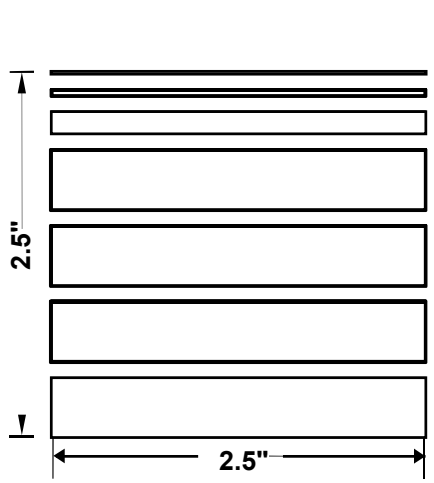
Optical Arrangement, Main FPA



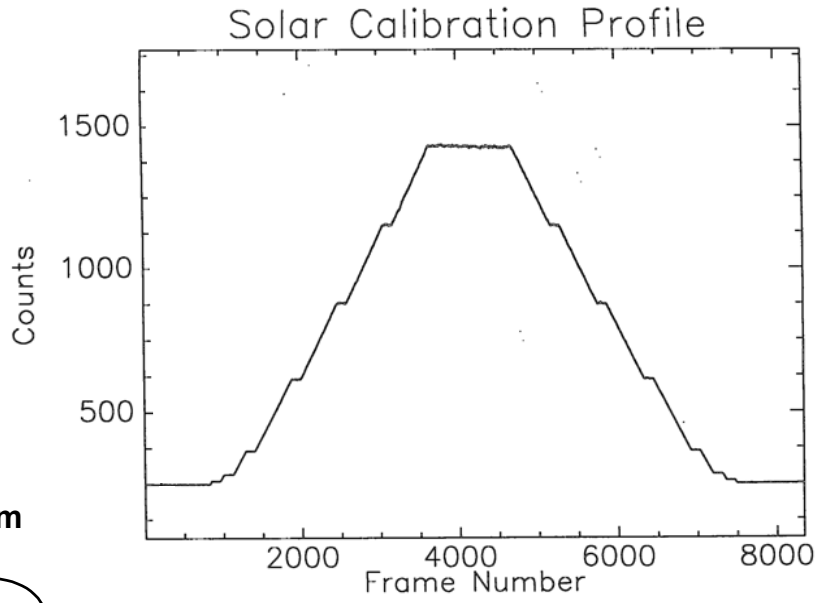
Detector Response to Reference Source

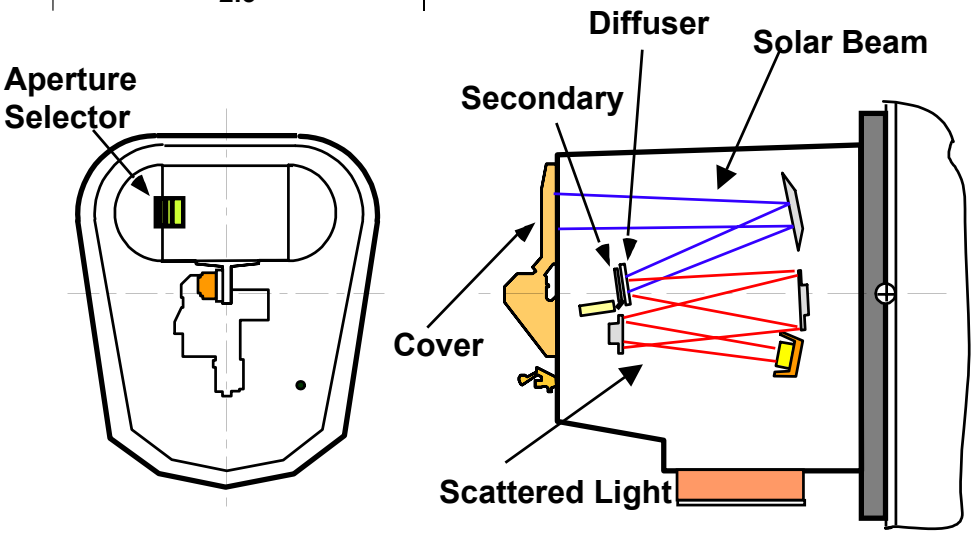


Solar Calibration

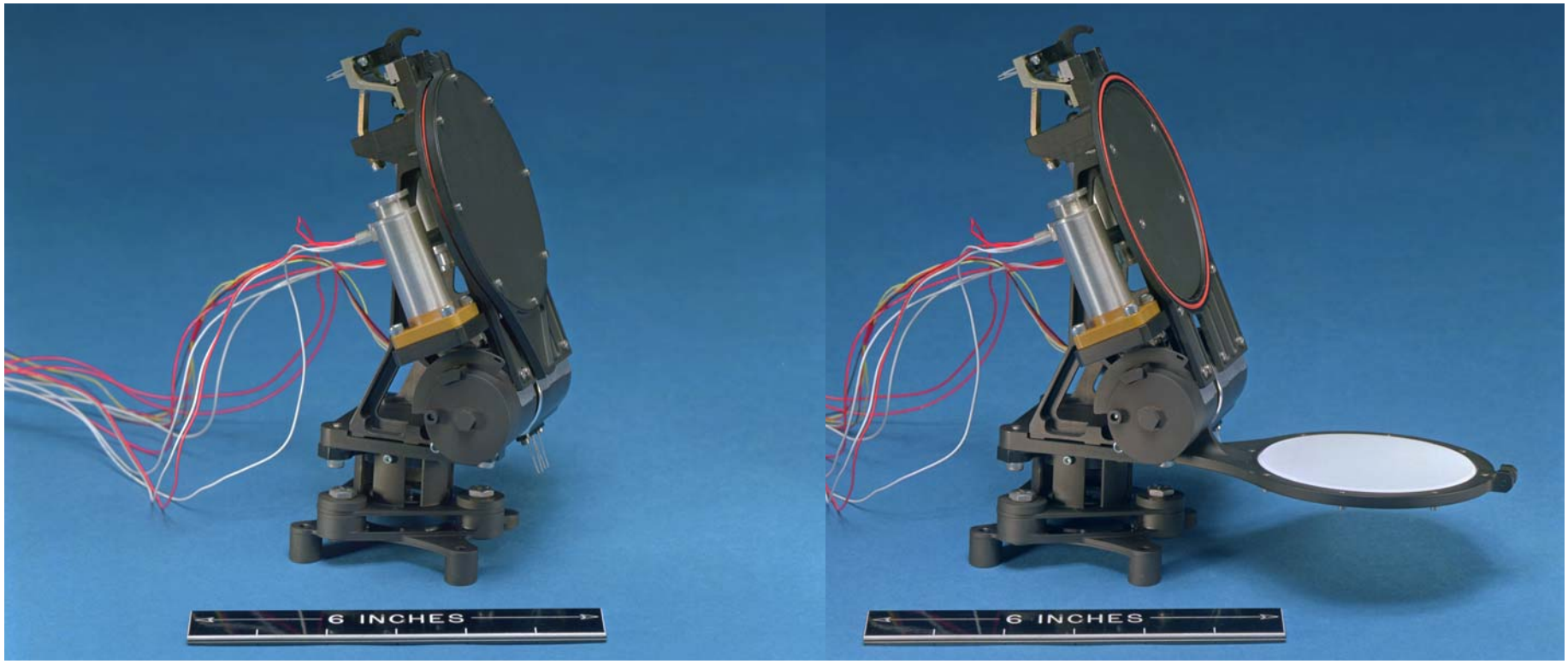


Signal Level	Cumulative Signal
1%	1%
2%	3%
7%	10%
20%	30%
20%	50%
20%	70%
20%	90%

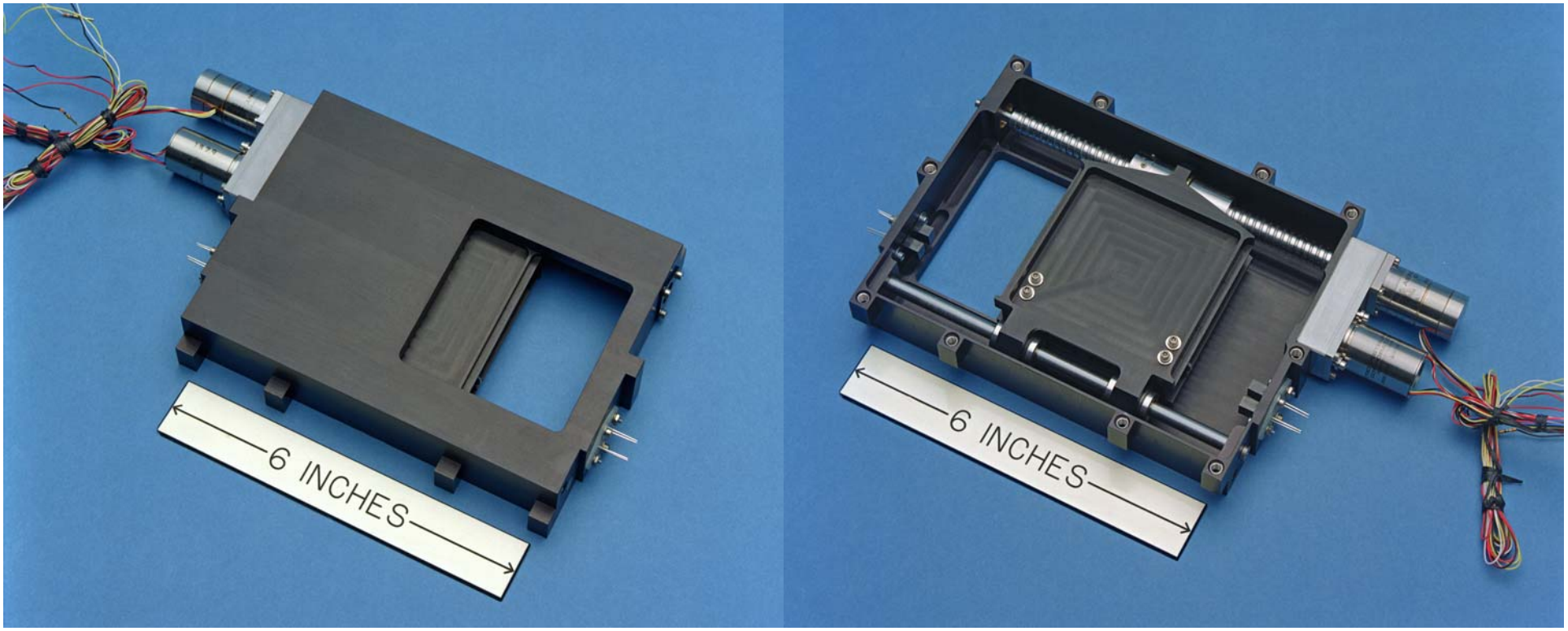




Calibration Diffuser Mechanism

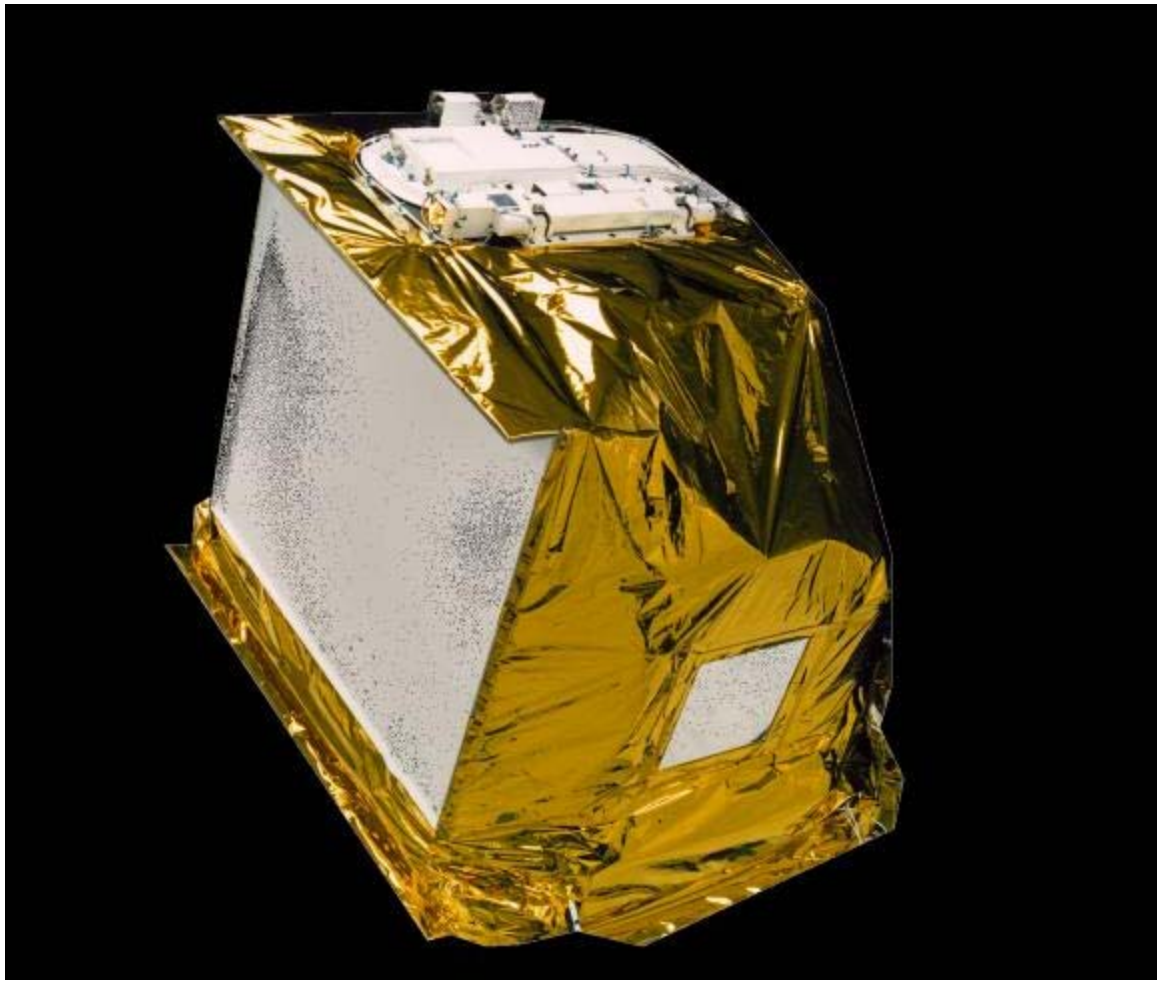


Aperture Selector Mechanism



ALI Flight Instrument

ALI as Delivered on March 16, 1999



Summary

- ***ALI is the primary instrument on the EO-1 mission of NASA's New Millennium Program***
- ***Comprehensive pre-launch characterization and calibration were conducted***
- ***The mission is now in progress and is successfully validating ALI technologies***
- ***Key performance specifications have been met***
- ***ALI provides path for low cost, high performance, remote sensing instruments***